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# ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY ADVANCED ROTARY WING AIRCRAFT

## SYSTEM/SEGMENT SPECIFICATION
## VOLUME V of V
## SIMULATION SYSTEM MODULE AH-64D KIT

Loral Systems Company
12151-A Research Parkway
Orlando, FL 32826-3283





31 March 1994

Contract No. N61339-91-D-0001
ARWA - Delivery Order No. 0048
CDRL A00E

Prepared for:

Simulation Training and Instrumentation Command
Naval Air Warfare Center
Training Systems Division
12350 Research Parkway
Orlando, FL 32826-3224

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## TABLE OF CONTENTS

## TABLE OF CONTENTS



## LIST OF FIGURES



## LIST OF TABLES

# 1. SCOPE

1.1 Identification. This specification establishes the functional requirements for the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS).

1.2 Purpose. This specification is intended to define the functional requirements for each of the aircraft simulations and the associated simulator support systems. The aircraft to be simulated are the AH-64D Apache Longbow and the RAH-66 Comanche.

1.3 Introduction. The ARWA SS provides the capability to engage in simulated war fighting exercises within the Battlefield Distributed Simulation Development (BDS-D) environment for the purpose of rapidly exploring tactics, doctrine and combat system development issues. The ARWA SS is a real-time, software intensive, network interoperable simulation capable of supporting reconfiguration to any combination of the two aircraft models. The software simulation is data driven to provide easy access to critical parameters for modification purposes in an experimentation environment. The ARWA SS consists of eight (8) devices which can be individually reconfigured in various combinations of the aircraft listed above.

# 2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

| | |
|---|---|
| PMT-90-W008 | Statement of Work, Rotary Wing Aircraft (RWA) Experimental AIRNET Simulators |
| ATZQ-TDS-SM | Memorandum for PM TRADE, ADST RWA SOW, Captain Major |
| MIL-STD-1815A 1983 | ADA Programming Language |
| MIL-STD-1777 | Internet Protocol Specification |
| MIL-T-23991 | Training Devices, Military; General Specification for |
| MIL-STD-454 | Standard General Requirements for Electronic Equipment |
| MIL-STD-1472 | Human Engineering Design Criteria for Military Systems, Equipment and Facilities |
| FED-STD-595 | Colors |
| MIL-H-46855 | Human Engineering Requirements for Military Systems, Equipment and Facilities |
| MIL-STD-483 | Configuration Management Practices for Systems, Equipment, Munition and Computer Programs |

2.2 Non-Government Documents. The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of conflict

between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

| | |
|---|---|
| ANSI X3.148-1988 | FDDI-Physical Layer Protocol |
| ANSI X3.166-1989 | FDDI-Physical Layer Medium Dependent |
| ANSI X3.139-1987 | FDDI-Token Ring Media ._. Control |
| ANSI X3T9.5/84-49 | FDDI-Station Management Rev 5.0 draft |
| PEI 89-103 Rev 3.4 | Xpress Transfer Protocol for draft copy - XTP Protocol Definition Protocol Engines, Inc. Santa Barbara, CA |
| 7S4-1985 | IEEE Floating Point Specification |
| IEEE 802.2 | IEEE Logical Link Control Specification |

## 3. REQUIREMENTS

3.1 System Definition. This specification defines the requirements for the development and test of the Advanced Rotary Wing Aircraft (ARWA) Simulator System (SS). This System is intended to provide the capability to engage in simulated war fighting exercises on the Battlefield Distributed Simulation Development (BDS-D) network for the purposes of rapidly exploring current and emerging tactics, doctrine, and combat development issues. The ARWA SS shall consist of two simulator stations (ARWA devices), with each station capable of being reconfigured between an AH-64D and an RAH-66, a Simulation Manager station, a Management Command and Control station, a Data Base Maintenance station and a Software Maintenance station. Each simulator station shall allow critical experimental parameters, listed in Appendix B of Volume I, to be changed without reprogramming.

3.1.1 System Functions. The ARWA SS software kit specific modules shall be limited to the SSM.

3.1.1.1 System Simulation Module. The System Simulation module is comprised of ten segments: flight controls, flight dynamics, propulsion, navigation/communication, weapons, sensor control, aircraft survivability equipment, physical cues, instructor/operator station and tactical and natural environment. Physical separation of the segments is not required. All segments except the control and tactical and navigation segments shall be software kit specific.

3.1.1.1.1 Flight Controls Segment. The flight controls segment shall simulate the flight controls of the AH-64D. Simulations shall include primary controls, trim, hinge moments, Enhanced Digital Automatic Stabilization Equipment (EDASE), miscellaneous control devices, and toe brakes. The flight controls simulation shall also include the ability to set and/or adjust certain device parameters including maximum pitch, roll and yaw rates: turning radius; flight controls input sensitivity; number of blades; no tail rotor effect on performance; and stochastic failures from combat and crash damage tables.

3.1.1.1.1.1 Primary Controls. The surface positions shall be determined from the cockpit control device inputs (cyclic stick, collective stick and directional pedals), EDASE inputs, hydraulic pressures, electrical power, and malfunction (battle damage) data. The

primary controls function shall include the simulation of surfaces or controls such as actuators, swashplates and blade pitch (main and tail).

3.1.1.1.1.2 Trim. The "cyclic trim" or "trim feel" function shall be modeled for the AH-64D. This shall include the force acting on the cyclic stick and directional control pedals to center and provide an artificial feel of being in a trim state.

3.1.1.1.1.3 Hinge Moments. The hinge moments function shall provide a simulation of hinge moments acting on the aerodynamic control surfaces of the baseline aircraft, if necessary, and shall restrict movement of those aerodynamic surfaces appropriately.

3.1.1.1.1.4 Enhanced Digital Automatic Stabilization Equipment (EDASE). The EDASE simulation shall provide the capabilities of heading hold, attitude hold, hover hold, and altitude hold as required for the AH-64D. Stability augmentation simulations shall provide improved stability in the pitch, roll and yaw axes by providing aircraft damping. The stability augmentation system shall oppose any deviation in attitude, but shall not return the aircraft to a given attitude or heading. The simulation shall provide for stability augmentation to be engaged at all times in pitch, roll and yaw mode. Sensed rate signals and Air Data System (ADS) inputs shall be used in determining pitching, rolling, or yawing motion.

3.1.1.1.1.5 Miscellaneous Control Devices. The miscellaneous controls including stabilator position and tail wheel locked status shall be simulated by this function. The normalized positions and states (e.g., open, opening, closed, etc.) of the miscellaneous control devices shall also be determined by this function. The stabilator position for the AH-64 series helicopters simulation shall support manual and automatic control only.

3.1.1.1.1.6 Toe Brakes. The simulation of braking effects shall be modeled for the AH-64D aircraft. The AH-64D shall use the top portion (toe) of the directional control pedals to provide the pilot control of the main gear brakes. The effects required to be supplied during braking operation shall include brakes on and off.

3.1.1.1.2 Flight Dynamics Segment. The Flight Dynamics segment for the AH-64D will be adapted from the aerodynamic model that exists in the AH-64D EDS and will be in the FORTRAN programming language, assuming modifications will be less than 40%. The Flight Dynamics segment shall provide for a realistic simulation of the flight characteristics of the simulated aircraft. The simulation shall include portions of the flight envelope which reflect combat operations such as: cruise, ascent, descent, hover, low-level (i.e., within ground effect) flight, approach and landing within a refueling/rearmament zone and subsequent takeoff from that zone. The simulation shall reproduce fidelity of flight operations to a level which will closely resemble that of the selected aircraft and which will not cause either distraction of the pilot or an increase or decrease in the performance of the air vehicle to an extent that would affect combat effectiveness or associated test results. The simulation shall include forces and moments, equations of motion, weight and balance, envelope violation, aerodynamics and ground handling. The flight dynamics simulation shall also include the ability to set and/or adjust certain device parameters to include maximum speed, fuel load time, maximum pitch, roll and yaw rates, turning radius, number of blades and no tail rotor effect on performance, failures from combat and crash damage, gross weight limitations, external fuel tanks, weapons selection, wing stores, internal stores configuration and load time for ammunition.

3.1.1.1.2.1 Forces and Moments. The forces and moments function shall combine the aerodynamic forces and moments acting on the damaged or undamaged aircraft with ground handling and propulsive forces and moments (including gyroscopic moments).

The forces and moments function shall perform forces and moments calculations based on the configuration of the aircraft including location, center of gravity (CG), weight, and moments of inertia of all external stores and internal fuel tanks as provided by the weight and balance function. Internal calculations from the forces and moments function of the Flight Dynamics segment shall also include stores release, weapons firing effects and battle damage. Body-axis forces and moments due to the aircraft propulsion system including gyroscopic moments shall be calculated based on engine thrust forces. Dynamic modeling of engine moments of inertia is not required. Simulation of forces and moments due to flow field effects while in the proximity of other aircraft is not required.

3.1.1.1.2.2 Equations of Motion. The equations of motion function shall determine the state of the aircraft. The state of the aircraft shall include translational accelerations, velocities, and positions; and rotational accelerations, velocities and positions. The state of the aircraft shall be provided in the earth axis coordinate system to the global bus for network distribution.

3.1.1.1.2.3 Weight and balance. The weight and balance function shall simulate mass properties information about the aircraft configuration. This information shall include basic aircraft dry weight configuration data, fuel data, cargo data weapon stores data. Data is defined as type and location, weight, CG (x, y and z body-axis locations) and products and moments of inertia of each component. Internal data about the dry aircraft shall be combined with fuel quantities per tank, cargo data and weapons stores data to determine aircraft weight, CG position and products and moments of inertia.

3.1.1.1.2.4 Envelope Violation. The envelope violation function shall monitor critical flight parameters of the simulated aircraft to determine if structural capacities of the aircraft have been exceeded resulting in a crash condition. The crash conditions shall include exceeding aircraft structural limitations in flight, excessive vertical velocities and excessive side velocities at touchdown. A crash override capability is not required. The system shall be able to quickly recover from a crash condition when commanded by the Simulation Manager station.

3.1.1.1.2.5 Aerodynamics. The aerodynamics function shall provide the modeling of the aircraft aerodynamic forces and moments. This shall include those effects generated by the airframe, main and tail rotors and stores during hovering and dynamic flight. The aerodynamics modeling shall reflect aircraft operation throughout the entire combat flight envelope to include ground effects and battle damage. Aerodynamic forces and moments due to weapon damage and/or soft crash (i.e., auto-rotate landing) shall be based on severity and location of damage. The simulation shall reproduce fidelity of flight operations to a level which will closely resemble that of the selected aircraft and which will not cause either distraction of the pilot or an increase or decrease in the performance of the air vehicle to an extent that would affect combat effectiveness or associated test results. Flow field effects (aerodynamic interaction) due to proximity to other aircraft or weapons is not required. Operation in high normal load factor (high G) environments is not required.

3.1.1.1.2.6 Ground Handling. The ground handling function shall provide a simplified model of the aircraft landing gear forces and moments when in contact with the ground. This modeling shall include the effects of strut compression, main gear brakes and structural overload. A high fidelity, low speed ground handling model is not required.

3.1.1.1.3 Propulsion Segment. The Propulsion segment shall provide the simulation of the engines and torque generation capabilities for the AH-64 D. This simulation shall include the core engine modeling, torque generation, transmission system, oil and fuel

systems for the T700-GE-701C engines installed on the AH-64D. The following paragraphs describe the required assumptions and simplifications for level of fidelity:

a. Simulation of engine start characteristics is not required. The engines shall initialize at flat pitch torque at normal operating revolutions per minute (RPM) when the simulator is initialized.

b. Simulation of engine bleed air and anti-ice characteristics is not required.

c. Auxiliary and/or secondary power units shall not be simulated.

3.1.1.1.3.1 Core Engine System. The Core Engine function shall provide propulsion data to the Flight Dynamics segment to propel the aircraft and to the Flight Station module to drive the Turbine Gas Temperature, Gas Generator Turbine Speed, and Power Turbine and Main Rotor Speed instruments. The turbine gas temperature, turbine speed and rotor speed shall be modeled as a function of power demands from the pilot's controls. Ambient pressure and ambient temperature effects on engine performance shall be simulated by standard temperature and pressure correction factors. The simplified algorithms shall provide instrument indications which are representative of those in the aircraft.

3.1.1.1.3.2 Torque Generation. The Torque Generation function shall provide outputs to the Flight Dynamics segment to propel the aircraft and to the Flight Station module to drive the Torque indicator. Simulation of engine fault codes for display on the Multi-function Display is not required. Torque shall be simulated in the 21 to 130 percent range.

3.1.1.1.3.3 Engine Fuel System. Engine fuel depletion shall be a straight line model as a function of torque.

3.1.1.1.3.4 Transmission System. Accessory drive and transmission gear losses shall be constant.

3.1.1.1.3.5 Engine Oil System. The Engine Oil system simulation shall provide a constant oil pressure indication except for battle damage conditions.

3.1.1.1.4 Navigation/Communication Segment. The Navigation/Communication segment shall provide the navigation and communication simulations for the AH-64D. Figure 3.1.1.1.4-1 identifies the specific equipment types that shall be simulated. These simulations shall include the Global Positioning System (GPS), AN/ASN-157 Doppler Radar Velocity Sensor (DVRS), Air Data System (ADS), and Inertial Navigation Unit (INU) which will be represented as a single "perfect" navigation system. Nav errors will not be generated and Nav Align will not be required, Intercommunications System (ICS), VHF communications, and UHF communications. The following paragraphs describe the requirements that apply to the navigation and communications equipment simulated.

| Aircraft Config | HARS/ AHRS | DNS | TACAN | ICS | VHF COMMS | UHF COMMS | AIR DATA | ATHS | MAP |
|---|---|---|---|---|---|---|---|---|---|
| AH-64D | INU | ASN-137 / MFD | NA | CCP | ARC-186 ARC-201(2) | ARC-164 | ADS | EATHS up to 16K Baud IDM | NA |

Figure 3.1.1.1.4-1 Nav/Comm Baseline

3.1.1.1.4.1 Inertial Navigation Unit (INU). The AH-64D INU simulation shall provide helicopter attitude outputs for pitch, roll, heading, velocities, and accelerations as required by other aircraft systems. Align mode control, alignment and self test simulation is not required.

3.1.1.1.4.2 Radio Navigation Aid System. Simulation of DNS accuracy degradation due to altitude and high pitch and roll angles is not required. Modes such as backup, hover bias calibration, and test modes are not required. Simulation of the Initiated Built In Test (IBIT) function is not required.

A generic Global Positioning System (GPS) shall be modeled to provide accurate position and velocity information for use by other systems.

3.1.1.1.4.3 Communications. The following radio communications equipment shall be simulated on the AH-64D: ICS, ARC-186 VHF-AM, ARC-201 VHF-FM, and ARC-164 UHF. Voice reception from crewmembers and other vehicles shall be possible at all times as long as the receiver select switches on the ICS panel are on and the volume is turned up. The simulation shall provide for monitoring of up to five radios. The Hot Mic and Mic switches functions are not required. Nav audio (Automatic Direction Finder (ADF) or Identification Friend or Foe (IFF)) monitoring are not required.

The ARC-186 VHF radios shall be functional in AM mode. D/F mode simulation is not required. Frequency selection shall be functional in the manual and preset modes but not in emergency mode. Squelch control or tone select functions are not required. Insertion of static and noise due to equipment interference, atmospheric conditions, or range is not required. The ability to receive communications shall be dependent on line of sight and proper operation of the ICS panel selections.

The ARC-164 UHF radio shall be fully functional, including the guard receiver. Squelch control, and tone select functions do not require simulation. The HAVEQUICK function does not require simulation. Insertion of static and noise due to equipment interference, atmospheric conditions, or range is not required. The ability to receive communications shall be dependent on line of sight and proper operation of the ICS panel selection.

The ARC-201 VHF-FM radios shall be fully functional. Squelch control and tone selection functions do not require simulation. The SINCGARS function does not require simulation. Insertion of static and noise due to equipment interference, atmospheric conditions, or range is not required. The ability to receive communications shall be dependent on line of sight and proper operation of the ICS control panel selections.

3.1.1.1.4.4 Air Data Sensor System (ADS). The simulation of the ADS shall provide the signals for airspeed, temperature, static pressure, and all air mass data required by other

aircraft systems. The ADS shall be modeled as always "on". Simulation of fault detection and isolation is not required.

3.1.1.1.4.5 Improved Data Modem (IDM). The IDM shall be simulated and shall interface properly through the Communications system. IDM communications shall be possible between all appropriately equipped aircraft and the Commander's workstation in the Tactical Operations Center (TOC). The IDM system will enable composition, transmission and receipt of free text, RF handover, priority fire/no fire zones, battle damage assessments and other pertinent tactical data.

3.1.1.1.5 Weapons Segment. The Weapons segment shall simulate all ownship weapons and weapon systems as defined Figure 3.1.1.1.5-1. The Weapons segment shall determine the ownship combat damage sustained as function of weapon proximity and detonation characteristics as defined by the BDS-D environment. The following limitations apply to Weapon segment functions.

a. All weapons are operable, armed, and ready after loading.

b. Crew functions associated with pre-launch stores management are not simulated.

c. Crew functions associated with post-launch stores management are not simulated.

d. All necessary power is available, and all equipment is powered on.

| Aircraft Config | Area Weapon System | Aerial Rocket System | Point Target System | Heat Seeking Missiles | Optical Guided Missiles |
|---|---|---|---|---|---|
| AH-64D | M-230E1 30 mm Gun | 2.75" RKTS MK-40 MK-66 | AGM-114A Hellfire RF Seeker Laser Seeker | ATAS | NA |

Figure 3.1.1.1.5-1 Weapons Baseline

3.1.1.1.5.1 Ownship Fire Control. The Weapons segment shall simulate the various effects of aircraft attitude and systems states at weapon launch and shall simulate the specific firing envelope for each weapon. This function shall simulate the fire control capabilities of the LONGBOW millimeter wave radar and its associated fire control computer as appropriate.

3.1.1.1.5.2 Ownship Weapon Dynamics. The Weapons segment shall simulate the flight of ownship released weapons. This simulation shall support internal and ownship guidance as appropriate. This simulation shall represent the weapon projectile as a point located at the projectile's center of gravity. The simulation shall represent the projectile in 5 degrees of freedom (no roll). The simulation shall represent the projectile mass as a constant during flight. It shall not support a full aerodynamic model. The Weapons segment shall provide support for simulation of the Hellfire missile. The simulation shall

provide representation of the weapon system components detailed in Figure 3.1.1.1.5-1. The simulation level of fidelity shall be sufficient to accommodate the adaptability parameters defined in Appendix B of Volume I.

3.1.1.1.5.3 Ownship Weapon Stores. The Weapons segment shall simulate the stores limitations for specific aircraft and associated weapons. The Weapons segment shall simulate a dynamic inventory of ordinance based on load, firing, jettison and reload.

3.1.1.1.5.4 Target Designation. The Weapons module shall simulate the interface with the target designation capabilities of the ownship Sensor Control segment and with other ships in the multi-simulator environment.

3.1.1.1.5.5 Ownship Combat Damage. The Weapons segment shall determine the damage to the ownship from detonation of ordinance and shall generate a level of severity for each detonation. Each segment shall simulate the specific effect of the detonation as appropriate for the location and severity for each detonation. The damage shall take on the following forms: airframe distortion affecting flight and/or loss of specific aircraft systems (weapons, aircrew survivability, engines, etc.). Airframe distortion shall be localized to fuselage, tail, rotor, nose, or gear.

3.1.1.1.6 Sensor Control Segment. The Sensor Control segment shall simulate the control functions of the fire control radar and sensor imaging systems associated with the AH-64D see Figure 3.1.1.1.6-1. The Sensor Control segment simulations shall include mode and parameter control, sensor pointing and dynamics, tracking and track loss, target detection, target analysis and symbology control.

| Aircraft Config | PNVS | TADS | IHADSS | HIDSS | MMW Radar | MMSS |
|---|---|---|---|---|---|---|
| AH-64D | AN/AAQ<br>-11<br>FLIR | AN/ASQ<br>-170<br>FLIR<br>DTV<br>DVO<br>LRF/D<br>LST/IAT | HDU<br>SSU<br>DAP<br>SEU<br>DEU | NA | FCR | NA |

Figure 3.1.1.1.6-1 Sensor Baseline

3.1.1.1.6.1 Mode and Parameter Control. The mode and parameter control function shall simulate the sensor sight, acquisition and video select capabilities of the AH-64D aircraft. This function shall provide the interface between sensor related cockpit controls and the Visual module.

3.1.1.1.6.2 Sensor Pointing and Dynamics. The sensor pointing and dynamics function shall simulate the pointing modes, slew rates and limits, and stabilization of the sensor turrets or platforms for the AH-64D aircraft. For the purposes of simulation the turret servos are considered to be critically damped with no oscillations. This function shall determine the field of view (FOV) and field of regard (FOR) for each of the sensors.

3.1.1.1.6.3 Tracking and Track Loss. The tracking and track loss function shall simulate the automatic tracking capabilities of the application aircraft. The simulation shall include Image Auto Track (IAT), Laser Spot Track (LST), and the various search modes as

applicable to the AH-64D aircraft. Tracking simulation shall be implemented with simplified prediction, measurement and correction algorithms. Intermittent track loss and reacquisition shall be simulated through probabilistic methods. Complete track loss shall also be simulated.

3.1.1.1.6.4 Target Detection. The detection process shall be probabilistic and based on range to target and associated signal attenuation. For the purposes of simulation target aspect angle, atmospheric refraction, degraded sensor resolution and modulation transfer function loss factors are not required in the probability calculation. The simulation shall include pseudo-random generation of sensor "false alarms". This function shall identify the target or terrain feature requiring track when an automatic tracking mode is engaged. Laser range finding and designation shall also be simulated.

3.1.1.1.6.5 Target Analysis. The target analysis function shall simulate the classification process of the aided target recognition capability for each of the applicable aircraft. Classification shall be an extension of the probabilistic methods used in target detection. The target analysis model shall be parameterized to permit incorporation of simulated recognition and identification capabilities when required.

The Longbow Radar Function will be representative of the AH-64D Fire Control Radar (FCR) system. The following modes and major capabilities will be represented: Ground Targeting Mode (GTM), Air-Targeting Mode (ATM), Terrain Profiles Mode (TPM); Radar Map (RMAP), PPI, TPM and ATM display modes, target detection and classification; C-scope and zoom features; TADS link operation; single and continuous scan operation; cued search (in conjunction with the RFI), however, no FCR video will be generated.

3.1.1.1.7 Aircraft Survivability Equipment (ASE) Segment. The ASE segment shall provide real-time simulation and modeling of ASE equipment types (e.g. warning systems, jamming systems, and expendable systems) onboard application aircraft. Figure 3.1.1.1.7-1 identifies the specific equipment types including configuration versions (V) that shall be simulated. Equipment shall be simulated in accordance with design criteria and interfaces provided as required to other segments except as noted herein, in subsequent paragraphs, and in paragraph 3.1.1:

a. Simulation of anomalous processing and display effects due to high signal power and high signal density are not required.

b. Signal propagation shall be influenced by Nap Of Earth (NOE) according to 4/3 earth curvature algorithms along with terrain and feature masking for objects provided in the Engineering Topographic Laboratory (ETL) data base. Simulation of signal propagation effects due to obscurants/dynamic weather is not required.

c. On-board equipment field of view (FOV) shall be provided through main beam and backlobe patterns. The main beam angular width shall be defined as the angular portion of the beam that is within 6 db of the peak value.

d. Capability shall be provided in a pre-mission (i.e. non real-time) environment for efficient modification of equipment critical processing parameter limits such as frequency, power output, and field of coverage. See Appendix B of Volume I.

e. Simulation of equipment malfunctions due to combat damage effects shall be provided.

| Aircraft Config | Radar Warning | Laser Warning | Radiac Warning | Chem Warning | Radar Jammer | IR Jammer | Chaff | Flare |
|---|---|---|---|---|---|---|---|---|
| AH-64D | APR-39 (V)1 (V)2 APR-48 | AVR-2 | NA | NA | ALQ-136 (V)1/5 | ALQ-144 (V)1/3 | M-130 | M-130 |

Figure 3.1.1.1.7-1 Aircraft Survivability Equipment (ASE) Baseline

3.1.1.1.7.1 APR-39 Radar Warning Receiver (RWR) System. The APR-39 RWR system simulation shall be capable of generating simultaneous visual effects of up to eight (8) signals and aural effects of up to five (5) signals. It shall provide the flexibility to generate any type of signal or combination of signals typical of threats in a ARWA environment within the aforementioned limitations. The following capabilities shall be provided:

Simulation of receiver system characteristics such as detection range and parameter limit detection (RF, PRF, and PW).

Simulation of processor characteristics shall be simulated such as algorithms for angle of arrival, direction finding and emitter identification via parameter matching. Priority processing shall be provided, as necessary, for the visual and aural simulation limits.

Missile detection activity shall be provided but crossband correlation simulation is not required. Missile tones shall have the proper audio tone, volume, and frequency.

Four (4) distinct threat signal audio tone types shall be provided to simulate audio tone, volume, and frequency(s) sufficient to permit threat mode classification to four types of operating modes (search, acquisition, track, launch) by the crewmember. Specific signal identification to a North Atlantic Treaty Organization (NATO) code name is not required.

The display and audio characteristics of multiple threat systems of the same NATO code name shall not appear synchronized.

Effects of pulse repetition frequency (PRF) and scan synchronization of multiple signals or other interactive effects between threat in the network shall not be simulated.

3.1.1.1.7.2 AVR-2 Laser Warning Receiver (LWR) System. The AVR-2 LWR system simulation shall be capable of generating simultaneous visual effects of up to 4 signals and aural effects of up to 4 signals as interfaced through the APR-39 RWR simulation. It shall represent signals or combinations of signals typical of threats in an ARWA environment. The following capabilities shall be provided:

Simulation of receiver system characteristics such as detection range and parameter limit detection (LF, LPRF, and LPW).

Simulation of processor characteristics shall be simulated such as algorithms for angle of arrival, direction finding and Laser emitter identification via parameter matching. Priority processing shall be provided, as necessary, for the visual and aural simulation limits.

Threat signal audio tones shall have the proper audio tone, volume, and frequency (s) to permit signal/mode type recognition by the crewmember. Specific signal identification to a NATO code name is not required.

3.1.1.1.7.3 Radiological Warning System (RWS). None required.

3.1.1.1.7.4 Chemical Warning System (CWS). None required.

3.1.1.1.7.5 ALQ-136 Radar Jammer. The ALQ-136 Radar Jammer system simulation shall be capable of interfacing with up to ten (10) simultaneous signals. The following capabilities shall be provided:

Simulation of receiver system characteristics such as detection range and parameter limit detection (RF, PRF, and PW).

Simulation of processor characteristics shall be simulated such as algorithms for angle o arrival, direction finding and emitter identification via parameter matching. Priority processing shall be provided, as necessary, for the simulation limits.

Simulation of RF jamming characteristics shall be simulated to the extent necessary to provide the interface into the DIS network protocol structure.

3.1.1.1.7.6 ALQ-144 Infrared (IR) Jammer System. The ALQ-144 IR jammer system simulation shall provide simulation of IR jamming characteristics (power, frequency(s), field of view) to the extent necessary to provide the interface into the DIS network protocol structure.

3.1.1.1.7.7 M-130 Chaff System. The M-130 chaff system simulation shall be capable of providing the following capabilities:

a. Simulation of loading M-l chaff (up to 30 cartridges) in the Payload module either during mission initialization or when "resupply" is requested by the DIS network. The chaff counter shall be operable to indicate inventory remaining.

b. Simulation of manual initiation of chaff program. Both manual and program chaff release types shall be operable.

c. Simulation of chaff dispense program parameters (e.g. SALVO, BURST) controlled by the Dispenser Electronic Module.

d. Simulation of dispensed chaff cloud characteristics to the extent necessary to provide the interface into the DIS network protocol structure.

3.1.1.1.8 Physical Cues Segment. The Physical Cues segment shall simulate the environmental sounds, navigation system tones and threat audio tones for the AH-64D aircraft. The simulated sounds shall include engines, rotors, small arms impacts, ownship weapons firings and weapon detonation,. Simulated tones shall include aircraft warning system synthetically generated tones, radar induced tones and navigation systems tones. The spectral content and loudness levels of these sounds and tones shall be dynamically controlled to represent realistic responses to simulated events. There shall be no motion system or motion cues provided.

3.2. System Characteristics. The system characteristic requirements for the AH-64D Kit shall be as specified in Paragraph 3.2 of Volume I of this specification.

3.3. AH-64D Processing Resources. The System Processing Resources requirements of Paragraph 3.3 of Volume I of this specification shall all to the processing resources of the AH-64D Kit.

3.4. Quality Factors. The requirements of Paragraph 3.4 of Volume I of this specification shall apply.

3.4.1. Reliability. The requirements of Paragraph 3.4.1 of Volume I of this specification shall apply.

3.4.2. Maintainability. The requirements of Paragraph 3.4.2 of Volume I of this specification shall apply.

3.4.3. Flexibility and Expansion. The requirements of Paragraph 3.4.3 of Volume I of this specification shall apply.

3.4.4. Availability. The requirements of Paragraph 3.4.4 of Volume I of this specification shall apply.

3.4.5. Portability. The requirements of Paragraph 3.4.5 of Volume I of this specification shall apply.

3.5. Logistics. The logistics requirements specified in Paragraph 3.5 of Volume I of this specification shall apply to the AH-64D Kit.

3.6. Precedence. The precedence requirements specified in Paragraph 3.6 of Volume I of this specification shall apply to the AH-64D Kit.

## 4. VERIFICATION REQUIREMENTS

4.1 General. The system level general verification events, levels and methods of testing for the AH-64D Kit are defined in Volume I of this specification, paragraph 4.1 and all subparagraphs of paragraph 4.1. For the AH-64D Kit operating in the MSS, there are no additional general verification requirements.

4.1.1 Philosophy of Testing. In addition to the testing philosophy identified in Volume I of this specification, paragraph 4.1.1, informal standalone module testing shall be conducted for the flight station module prior to integration with the system. The intent of these tests shall be to identify and resolve any unique module related deficiencies prior to system integration thus reducing integration problems.

4.1.1.1 Testing Events. Scheduled testing shall take place sequentially in the following phases.

4.1.1.1.1 Verification Test. Verification test at a system level shall be conducted as specified in Volume I of this specification, paragraph 4.1.1.1.1. Module level verification testing shall be accomplished prior to shipment of the module to the integration facility and shall ensure that the module meets the functional and performance requirements of this volume of the specification.

4.1.1.1.2 Acceptance Test. Acceptance test at a system level shall be conducted as specified in Volume I of this specification, paragraph 4.1.1.1.2. Module level acceptance testing shall consist of installation and checkout of the module at the integration facility and accomplishment of a subset of the module level verification tests to ensure that the module meets the functional and performance requirements of this volume of the specification in the installed configuration.

4.1.2 Location of Testing. All system level testing shall be accomplished in the locations identified in Volume I of this specification, paragraph 4.1.2. All module level verification testing shall be accomplished at the module builders facility. All module level acceptance testing shall be accomplished at the system integration facility.

4.1.3 Responsibility for Tests. The responsibility for system level testing shall be as defined in Volume I of this specification, paragraph 4.1.3. The responsibility for module level testing shall be allocated to the module builder and system integrator.

4.1.4 Verification Methods. Verification methods shall be as defined in Volume I of this specification, paragraph 4.1.4.

4.2 Formal Tests. Formal test shall consist of functional and performance testing.

4.2.1 Performance Evaluation. Performance evaluations which verify the design and development of the configuration items shall be performed to test that the design and performance of the configuration items meet the requirements specified in paragraph 3.1 of this Volume and Volume I of this specification. Performance evaluation shall consist of inspections, analyses, demonstrations and tests.

4.2.3 Reliability and Maintainability. Reliability and maintainability testing shall not be performed.

4.2.4 Test Equipment. Test equipment requirements applicable to all modules are described in Volume I of this specification, paragraph 4.2.4. There is no additional module unique test equipment required to verify that the configuration items and assembled module meet the requirements specified in paragraph 3, Requirements, of this Volume and Volume I of this specification.

4.3 Formal Test Constraints. The formal test constraints for the ARWA SS system are described in Volume I of this specification, paragraph 4.3. There are no additional formal test constraints unique to the AH-64D Kit.

4.4 Verification Cross Reference. Table 1, AH-64D Kit Verification Cross Reference Matrix, provides a requirements/verification cross reference guide for the AH-64D Kit using the definitions provided in Volume I of this specification, paragraph 4.1.4.

| Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test | | | | | | |
|---|---|---|---|---|---|---|
| Section 3 Requirements Reference | Qualification Method(s) | | | | | Section 4 Qualification Requirement Reference |
| | NA | I | A | D | T | |
| 3. | NA | | | | | |
| 3.1 | NA | | | | | |
| 3.1.1 | NA | | | | | |
| 3.1.1.1 | NA | | | | | |
| 3.1.1.1.1 | NA | | | | | |
| 3.1.1.1.1.1 | | | | D | | 4.2.1 |
| 3.1.1.1.1.2 | | | | D | | 4.2.1 |
| 3.1.1.1.1.3 | | | | D | | 4.2.1 |
| 3.1.1.1.1.4 | | | | D | | 4.2.1 |
| 3.1.1.1.1.5 | | | | D | | 4.2.1 |
| 3.1.1.1.1.6 | | | | D | | 4.2.1 |
| 3.1.1.1.2 | NA | | | | | |
| 3.1.1.1.2.1 | | | | D | | 4.2.1 |
| 3.1.1.1.2.2 | | | | D | | 4.2.1 |
| 3.1.1.1.2.3 | | | | D | | 4.2.1 |
| 3.1.1.1.2.4 | | | | D | | 4.2.1 |
| 3.1.1.1.2.5 | | | | D | | 4.2.1 |
| 3.1.1.1.2.6 | | | | D | | 4.2.1 |
| 3.1.1.1.3 | NA | | | | | |
| 3.1.1.1.3.1 | | | | D | | 4.2.1 |
| 3.1.1.1.3.2 | | | | D | | 4.2.1 |
| 3.1.1.1.3.3 | | | | D | | 4.2.1 |
| 3.1.1.1.3.4 | | | | D | | 4.2.1 |
| 3.1.1.1.3.5 | | | | D | | 4.2.1 |
| 3.1.1.1.4 | NA | | | | | |
| 3.1.1.1.4.1 | | | | D | | 4.2.1 |
| 3.1.1.1.4.2 | | | | D | | 4.2.1 |
| 3.1.1.1.4.3 | | | | D | | 4.2.1 |
| 3.1.1.1.4.4 | | | | D | | 4.2.1 |
| 3.1.1.1.4.5 | | | | D | | 4.2.1 |
| 3.1.1.1.5 | NA | | | | | |
| 3.1.1.1.5.1 | | | | D | | 4.2.1 |
| 3.1.1.1.5.2 | | | | D | | 4.2.1 |
| 3.1.1.1.5.3 | | | | D | | 4.2.1 |
| 3.1.1.1.5.4 | | | | D | | 4.2.1 |
| 3.1.1.1.5.5 | | | | D | | 4.2.1 |
| 3.1.1.1.6 | NA | | | | | |
| 3.1.1.1.6.1 | | | | D | | 4.2.1 |
| 3.1.1.1.6.2 | | | | D | | 4.2.1 |
| 3.1.1.1.6.3 | | | | D | | 4.2.1 |
| 3.1.1.1.6.4 | | | | D | | 4.2.1 |
| 3.1.1.1.6.5 | | | | D | | 4.2.1 |
| 3.1.1.1.6.6 | | | | D | | 4.2.1 |
| 3.1.1.1.7 | NA | | | | | |
| 3.1.1.1.7.1 | | | | D | | 4.2.1 |

Table 1. AH-64D Kit Verification Cross Reference Matrix

| Legend: NA-Not Applicable I-Inspection D-Demonstration A-Analysis T-Test | | | | | | |
|---|---|---|---|---|---|---|
| 3.1.1.1.7.2 | | | | D | | 4.2.1 |
| 3.1.1.1.7.3 | | | | D | | 4.2.1 |
| 3.1.1.1.7.4 | | | | D | | 4.2.1 |
| 3.1.1.1.7.5 | | | | D | | 4.2.1 |
| 3.1.1.1.7.6 | | | | D | | 4.2.1 |
| 3.1.1.1.7.7 | | | | D | | 4.2.1 |
| 3.1.1.1.8 | | | | D | | 4.2.1 |
| 3.2 | | I | | | | 4.2.1 |
| 3.3 | | I | | D | | 4.2.1 |
| 3.4 | NA | | | | | |
| 3.4.1 | | | | D | | 4.2.1 |
| 3.4.2 | | | | D | | 4.2.1 |
| 3.4.3 | | | | D | | 4.2.1 |
| 3.4.4 | | | | D | | 4.2.1 |
| 3.4.5 | | | | D | | 4.2.1 |
| 3.5 | | | | D | | 4.2.1 |
| 3.6 | | | A | | | 4.2.1 |

Table 1. AH-64D Kit Verification Cross Reference Matrix [Continued]

## 5. PREPARATION FOR DELIVERY

The preparation for delivery requirements for the ARWA SS are specified in Volume I of this specification, paragraph 5. There are no additional or specific preparation for delivery requirements applicable to the AH-64D Kit.

## 6. NOTES

6.1 AH-64D Kit Acronyms. The acronyms contained in this paragraph are unique to the AH-64D Kit and are in addition to the ARWA SS acronyms contained in Volume I of this specification, paragraph 6.1.

| | |
|---|---|
| ADSS | Air Data Sensor Subsystem |
| ADF | Automatic Direction Finder |
| ARWA | Advanced Rotary Wing Aircraft |
| AFCS | Automatic Flight Control System |
| AHRS | Attitude and Heading Reference System |
| AM | Amplitude Modulation |
| ATHS | Automatic Target Handover System |
| BDS-D | Battlefield Distributed Simulation - Development |
| CADC | Central Air Data Computer |
| CDU | Computer Display Unit |
| CG | Center of Gravity |
| CPG | Copilot/Gunner |
| db | decibel |
| D/F | Direction Finding |
| DIS | Distributed Interactive Simulation |

| | |
|---|---|
| DNS | Doppler Navigation System |
| DOD | Department of Defense |
| DTV | Day Television |
| DVO | Direct View Optics |
| ECS | Environmental Control System |
| ETL | Engineering Topographic Laboratory |
| FD/LS | Fault Detection/Location System |
| FLIR | Forward Looking Infrared |
| FM | Frequency Modulation |
| FOV | Field of View |
| HARS | Heading and Attitude Reference System |
| HF | High Frequency |
| HOL | High Order Language |
| ICS | Intercom System |
| IFF | Identification Friend or Foe |
| IOS | Instructor/Operator System |
| IR | Infrared |
| LF | Low Frequency |
| LOS | Line of Sight |
| LPRF | Laser Pulse Repetition Frequency |
| LPW | Laser Pulse Width |
| LRF/D | Laser Range Finder/Designator |
| LST | Laser Spot Tracker |
| LWR | Laser Warning Receiver |
| MCC | Management Command and Control |
| MFD | Multi-function Display |
| MMS | Mast Mounted Sight |
| MSE | Multiple Simulator Environment |
| NATO | North Atlantic Treaty Organization |
| NOE | Nap of Earth |
| NVG | Night Vision Goggles |
| OTW | Out the Window |
| PNVS | Pilot Night Vision System |
| PRF | Pulse Repetition Frequency |
| PW | Pulse Width |
| RADIAC | Radiological |
| RF | Radio Frequency |
| RFD | Remote Frequency Display |
| RWR | Radar Warning Receiver |
| SAD | Situational Awareness Display |
| SCAS | Stability and Control Augmentation System |
| SOW | Statement of Work |
| SS | Simulator System |

| | |
|---|---|
| TADS | Target Acquisition Designation Sight |
| TBD | To Be Determined |
| TBR | To Be Resolved |
| TBS | To Be Supplied |
| TIS | Thermal Imaging System |
| TNE | Tactical and Natural Environment |
| TOC | Tactical Operations Center |
| TVS | Television Sensor |
| UHF | Ultra High Frequency |
| V | Version |
| VHF | Very High Frequency |